VOL. 14 JULY, 1941 NO. 3

Journal

OF THE

Kansas Entomological Society

PUBLICATION COMMITTEE
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1889-1929

Entered as second-class matter June 7, 1939 at the Post Office at Manhattan, Kansas, under the Act of August 24, 1912

Kansas Entomological Society

Volume 14 July, 1941 Number 3

THE ROLE OF PLASTICS IN THE FIELD OF ENTOMOLOGY

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One need only to look around him to know that we are entering, if not well into, the Age of Plastics. More and more products of synthetic plastics of various kinds are appearing on the markets constantly. Recent progress in this field is due to the development of new types of resins, from which plastics are made, and to new applications for older plastics. In many instances plastics have supplanted glass, ivory, china, rubber, metal, wood and cloth, in industry and in arts, as well as for every day use in the office and in the home. The development of resins has been partly due to the diminishing supply of the products of nature and partly because these natural products lack certain essential qualities which industry demands. The endeavor of the chemist is not only to imitate natural substances but to improve on them. As yet there is no perfect plastic material but, gradually, the chemist is overcoming their deficiencies. Most manufacturers want a resin having a higher melting or softening point than is found in most of the present plastics and one that has a hard lustrous surface which will resist shock, wear and abrasion. With this they want greater mechanical strength, resistance to water, heat, the weak alkalies and acids, and nonflammability. Of course the absence of objectionable odors and the presence of pleasing colors is often desirable.

No general or complete article, dealing with this subject, can be written which represents the last word in the rapid progress in this field since new discoveries are constantly improving old formulas and new ones are being developed. Perhaps, before this article appears in print, several plastic resins which, heretofore, have had but limited uses may be in great commercial demand due to improvements in the chemicals used or in slight changes in the manufacturing processes. Each new modification adds to the number and variety of its uses.

The exhibits at the San Francisco and New York World Fairs showed many interesting uses for plastics. They are finding a multitude of uses in public buildings, in the construction and adornment of homes, as well as in air, steamship and railroad transportation. These latter find that plastics are lighter in weight, durable in service, lower in cost and attractive to the eyes of the traveling public.

In giving the characteristics of any plastic one must take into consideration its chemical nature, its method of manufacture, whether used alone or with fillers, and many other things. Changes can be made in the specific gravity, hardness, and some of the other characteristics of the plastic substances by altering the time or method of cure. In the following discussion of the different kinds of plastics, they are considered without the use of fillers or reinforcements of any kind although some reference will be made to such fillers.

Before discussing this subject it might be well to explain the meaning of several terms used in the plastic trade in non-technical language. A plastic material is a combination of organic compounds which, under the influence of heat and pressure, becomes sufficiently soft to permit forming to shape. A resin is a synthetic or artificial gum made from chemicals. In molding plastic articles, the manufacturer uses materials that are thermoplastic, thermosetting or cold molded. Thermoplastic, or heat softening materials, are those which are softened under the action of heat and pressure, without a chemical change taking place, and then chilled before removing from the mold. Once cooled, they retain their shape unless subjected to temperatures which again bring them to the softening stage. These temperatures will vary with the different materials from 130° to 180° F., or even higher, with some of the more recent plastics. Thermosetting, or heat hardening, materials are originally thermoplastic but when heat is applied it brings about a complete chemical change. Once cooled they become a homogeneous, insoluble mass incapable of being shaped again by heat. In the cold molded process, soft, powdered materials are subjected to great pressure at room temperatures and later cured in heated containers. These are grouped into three classes depending on the kind of binders used, namely those using bitumen, cement or resin. The cheapness of cold molding is its principal advantage and so it is used with low-cost binders.

Plastic products vary in the manner in which they are molded. Formerally most of the items were from compression molds but a newer development is injection molding where the preheated plastic material, or resin, is squirted into dies, or molds, under direct pressure and instantly cooled before being ejected.

The coal-tar resins are very important ones in the plastic industry because of the plentiful supply of the raw materials, their hundreds of beautiful colors, adaptability and freedom from deterioration by many of the chemicals.

Phenol-Formaldehyde Resins (Resinoids): These thermosetting plastics are made from phenol and formaldehyde and are usually black, brown, or the darker shades of red, blue and green. The darker shades of color result from the fact that phenolic materials

in their liquid state are amber in color. The molded variety of this plastic contains fillers, such as wood flour, asbestos, minerals or fabric. The cast resins usually do not contain fillers but are cast in lead molds and allowed to cure instead of being molded with steel dies under pressure. First the materials are heated in a kettle, poured into hand ladles and from them into a series of lead molds. Such castings can be ordered from the factory in the form of sheets, rods or tubes.

In its finished form this plastic is non-inflammable, odorless, tasteless, and when properly treated, is one of the most beautiful of all the plastics. It has a luster and depth of color that give it the effects of fine minerals and precious stones. It has about the same machining characteristics as brass or wood, absorbs little moisture, resists alcohol, oils and common acids. Among the more common uses for this type of plastic are: knobs and handles on autos, book ends, games, clocks, cameras, knife handles, lamp bases, pen sets, phonoghaph records, dental plates and a score of others. Their heat resistance is shown by their use as heater plugs, cooking utensil handles and permanent wave machines. Because of their hardness they can be used for football cleats, silent gears, etc. Other plastics are used for the lighter pastel shades of water-white colors.

Polystyrene: This comparatively new thermoplastic material is made from styrene and the purity of the latter influences the properties and behavior of the plastic. Light, high temperatures, and the presence of certain catalysts cause the transparent, colorless styrene to thicken and polymerize into a hard transparent resin. Chemically this plastic has a long chain of single styrene molecules. Rapid polymerization results in many short chains while slow polymerization gives fewer but longer chains. They are similar but differ in strength when molded. Polystyrene has excellent insulating qualities, the highest of any available synthetic resin and can be used in place of hard rubber, celluloid, ebonite, vulcanite, wood or glass. It has remarkable high shock-resistance and is stronger than the phenol-formaldehyde resins. Among its outstanding characteristics are its crystal-like clarity, its hardness, low water absorption and its resistance to alcohol, strong alkalies and acids. It has a specific gravity of about 1.06, refractive index of 1.50 to 1.75 and a transverse tensile strength of about 6000 pounds per square inch. It has been used for gift boxes, dishes, and many other outlets are being found for it.

Cellulose Plastics: While cellulose plastics can be made from wood, the most important base for the manufacture of nitrocellulose is cotton. From this material the industry produces most of the cellulose plastics.

Cellulose nitrate (celluloid and pyroxylin): This was the first man-made plastic and was developed to take the place of tusk ivory in billard balls. It is a mixture of nitrocellulose and camphor. One finds a great variety of color shades, in transparents, translucents, apaques and variegated, which can be made to represent ivory, horn, tortoise shell, mother-of-pearl, onyx, quartz, marble, lapis lazule, semiprecious stones and rare woods.

This plastic is cheap, takes a high lustrous polish, does not warp, and is impervious to moisture. It has the disadvantage of being highly inflammable and the camphor gives it the "celluloid odor" that is objectionable under certain circumstances. One can purchase this product in sheets, slabs, rods and tubes, in about the same sizes as the cellulose acetate. Its uses are myriads being one of the first materials used in safety glass, colored fountain pen barrels and in photographic films. Also, it is used in toys, novelties, ping pong balls, toothbrush handles, combs, dental plates and transparent drawing devices. Strength and toughness is shown by its use in tool handles, mallet-heads, golf-club facings, and its workability in that it can be softened and stretched over wood to produce heels for shoes, toilet seats and covers.

Cellulose acetate: This is a comparatively new thermoplastic material made by treating cotton linters with acetic acid and acetic anhydride in the presence of a catalyst. When mixed with suitable plasticizers, pigments and dyes it is ready for the molding operations. While it supports combustion it burns very slowly. This plastic has unsurpassed strength and beauty, and its horn-like toughness, uniform texture and high luster make it ideal for many industrial and decorative uses. Because of its toughness and resilience it is well adapted to thin-walled products where other types of plastics are inadequate because of their brittleness. It is available in hundreds of colors from white, through the pastel shades to black, in clear shades or mottled and variegated designs. Any color that is originally fast will remain fast in this material. This plastic can be formed to shape by either compression or injection molding undergoing no chemical change in the process. It can be obtained in sheets, blocks, rods or tubes in various sizes, as well as in the molding powder. It is safer to use than the cellulose nitrate in places where it might come in contact with heat because of its slow burning qualities. Because of this fact it is widely used in photographic and moving picture films. Hundreds of uses have been found for it, especially in automobile steering wheels, handles and instrument panels, in colored telephones, door knobs and in other places where it is desired to withstand considerable wear. It has no odor or taste, is low in heat conduction and pleasant to touch.

Textiles (rayon) made from this substance will imitate silks and even surpass them in luster. It is uninjured by contact with vegetable and most mineral oils but strong acids and alkalies attack it. Cellulose ecetate costs more than glass by the piece but is much lighter in weight, there being about 21.6 cubic inches to the pound. Its specific gravity is about 1.3 and will withstand temperatures of 160° F. or higher.

Cellulose acetate butyrate (acetobutyrate plastic): The chemical origin of this plastic is related to that of cellulose acetate except that it is made from an entirely different cellulose ester. It is said to have all the advantages of both cellulose acetate and cellulose nitrate with practically none of their disadvantages. In moisture absorption it is about the same as the nitrate and about half that of the acetate. It flows freely as its critical temperature is reached, resembling metals in this respect. This means that a smaller amount of plasticizer is needed. This plastic is particularly suited for applications which require resistance to distortion under varying degrees of heat and humidity. Its specific gravity is about 1.2.

Ethyl cellulose: This is a thermoplastic material that is resistant to dilute acids and alkalies, to sunlight, heat and water. It has a low softening point, low flammability and its molded products have a hard, glossy surface together with good shock resistance. This plastic has limited uses as yet since it is still undergoing development and refinement.

Protein Plastics: Both animal and vegetable materials have been used as a base for plastics in a wide field of industry. Among the farm products that are being experimented with are soy beans, peanuts, corn and many others. In most cases they have not shown as much adaptibility as are found in some of the chemical materials. They are, however, being greatly improved and are finding a place in the building and automobile idustries.

Casein-formaldehyde Plastic: A good grade of rennent casein powder is mixed with water and colors are added if desired. This gummy mass is extruded under pressure through a heated nozzle into a rod, tube or ribbon. Sheets are made by compressing the rods while they are still warm or by cutting blocks of the material. After leaving the machine, this plastic is hardened and steralized by steeping in a dilute solution of formaldehyde. This process is followed by drying where the excess moisture is gradually removed.

The casein-formaldehyde plastic is completely non-inflammable and can be molded or worked with the ordinary tools. It is cheap to produce and takes a brilliant polish, being chiefly used for buttons, combs, knitting needles, auto fittings, as well as many ornaments. Hollow threads of this plastic have been produced which have the in-

sulating value of sheeps wool so that, if necessary, one could have suits and blankets made out of milk. Among its objectionable features is the fact that it absorbs moisture somewhat and is attacked by acids and alkalies.

Other Plastics: There are other types of plastics, developed within the past few years, that are proving to be very valuable.

Methacrylate Resin (plexoglas and lucite): Basically this plastic is made from air, coal and water. The resinous products are obtained by the polymerization of the esters of methacrylic acid. Depending on the manner of synthesis this material can be produced in varying degrees of hardness from soft, sticky semi-liquids to hard, tough, thermoplastic solids. The solid form possesses extraordinary colorless transparency, stability against aging and chemical resistance to many reagents. It has a high impact strength, low specific gravity (1.18) and is easy to form to a desired shape.

This plastic can be purchased in rods, tubes, sheets, or in the powder form. The rods come in various diameters and lengths up to 48 inches while the sheets come in thicknesses from 0.60 up to 2 inches. Tubes are made in various thicknesses, diameters and lengths.

The rods can be machined and manufactured into novelties, models, advertising signs, or in surgical and scientific instruments. These rods will transmit, or "pipe," 90 to 92 per cent of the light even if it is bent, in this respect resembling quartz. The optical properties of this plastic are such that it is used in spectacle lenses, magnifying glasses and protecting goggles. It is used for dental plates and in airplanes. Dozens of uses have been applied to this plastic and its possibilities are almost unlimited.

Among the more recent developments, using the plastic sheets or powders, is the embedding of insects, flowers and vegetables whereby they retain their natural shape and color for years without deterioration.

Urea-formaldehyde: This molded thermosetting plastic was developed principally to provide lighter colors than were available with the earlier produced phenol-formaldehydes resins. It is made from urea-formaldehyde resin, filler, pigments and plasticizers which, upon being heated, soften into a plastic mass that can easily be molded. These molds are kept dust-free and are usually made of stainless steel or are chromium plated to give a better finish to the product. After flowing for a few seconds the compound undergoes a chemical change and is converted into an infusible, hard, strong and insoluble form, taking its shape from the die. Usually after the finishing operations it is ready for use. The commercial product is available in a complete range of standard, color-fast shades, from natural colorless, and pure white, through the pastel shades and brilliant hues to jet black. A large number of translucent, semi-opaque and

opaque special colors are also available. In other words the range of colors is almost unlimited.

The finished plastic has a smooth, high luster that does not chip, rust or corrode. It is resistant to the common organic solvents, such as alcohol and acetone, also to the weak alkalies. Strong acids and alkalies do effect it. It is completely tasteless and odorless as shown by its use on tableware and kitchenware. This material can be tooled and is free from surface arcing. The natural, unpigmented compound is highly translucent, giving high light transmission with an exceptional degree of diffusions making it excellent for semi-indirect lighting fixtures. Hundreds of other uses are on the market, among them being: buttons, buckles, costume jewelry, as well as cases for radios, refrigerators, clocks and scales. The textile industry uses the emulsions of this plastic to make their product creaseproof.

Vinyl resins (Vinylite, Butacite, etc.): The most important plastic in this group of resins is made of a combination of vinyl acetate and vinyl chloride. They are produced as a white, fluffy powder which produces transparent, translucent or opaque articles in the most delicate of pastel shades. They have low moisture absorption and resist most chemical reagents. Articles molded from these resins do not warp, shrink or tend to distort. Records for transcribed radio programs are made of vinyl resins. They are lighter, stronger and less brittle than old shellac records formerly used. Other uses for this material are: bottle caps, poker chips, radio parts, airplane windows, flashlight lenses, and floor tile.

Past Uses of Plastic in Entomology: The plastics most generally used by entomologists, in the past, have been celluloid (cellulose nitrate), and cellophane (cellulose acetate complex). Both of these materials have been employed in the construction of insect breeding cages because they are light in weight, transmit most of the light rays, and the operator can easily observe the activity within the cage. Celluloid has an advantage in that it is rigid enough to need no supporting frame, soft enough that it can be cut or punched and because of its thermoplastic nature, can easily be warmed and shaped as desired. By softening with amyl acetate intricate cages or traps can be made. In some cases the "celluloid odor," due to the camphor in its preparation, has been a drawback in some kinds of experimental work. The cellophane is odorless and tasteless but so thin that it is usually used on a supporting frame of metal, glass or wood. Celluloid has been used for cyanide bottles, window in insect cages, deflector cones in light traps or for microscopic observation cages for small, living insects. Cellophane has been used to cover larval burrows so that one can watch developments and still keep out the air. Colored cellophane make excellent light filters, and have been used in light

traps. Cellulose acetate is advertised in Ward's Natural History Establishment catalogue for use in mounting tiny insects, or genetalia, between disks or on points.

Other plastic materials that have been used are methacrylate, cellucotton, cel-o-glass and masonite. The methacrylate has been used for substage illumination of microscopes as well as for magnifying lenses. Two reasons why plastic lenses have not been more generally used in optical and photographic equipment is their tendency to scratch easily and because they do not have the so-called "optical surface" without further grinding. Compression molded lenses are slower to make than those made by the injection method but they have a harder surface. Polystyrene and cellulose acetate are also being used for this purpose. The first two are preferred in the order mentioned while the latter is probably more shock resistant. Cellucotton has been suggested for packing and shipping insects and cel-o-glass for insect cages and for a part of the outside construction of insectries. Masonite has been used for spreading boards, cages, constant temperature cabinets.

Possible Future Uses for Plastics in Entomology: As mentioned earlier, plastics are slowly "supplanting glass, ivory, china, rubber, metal, wood, cloth, etc." in many of our industrial uses. In entomology they will compete chiefly with glass, rubber, wood, cloth and metal.

In competing with glass one will find that plastics cost more at the present time and are not as universely sold but they have advantages to offset this. Among these are their lighter weight, ease of shipping and lower freight rates, greater diversity of kinds, thicknesses, shapes and colors. They are easily fashioned into almost any desired shape and are resistant to shattering, rusting, chipping or corrision. In some cases they have taken the place of windows in buildings keeping out the weather and transmitting the ultra-violet light rays. Several of the transparent plastic materials, like cellulose nitrate, cellulose acetate and vinyl plastics are ideal for insect breeding cages on branches of trees, bushes, etc., where the weight of glass might be a limiting factor. On cages in the insectry their lack of weight might cause them to blow over, if not properly supported. However, there is little loss from breakage. Most of the transparent plastics will transmit ultra-violet rays and, with a multitude of colors to choose from, one can get almost any length of light ray in the chromic scale.

Wood is comparatively cheap, easy to obtain and can be worked by anyone with a few simple tools. Plastics would probably not compete with it for all general purposes but there are many places where they might prove to be superior, due to their elasticity, transparency, freedom from weathering, from attacks by bacteria, fungus

diseases or by insects. Where hundreds or thousands of simple articles are to be fashioned plastics might prove to be superior to wood for, once the mold is made, they can be produced cheaper and more accurately than when fashioned from wood. According to Modern Plastics, a fir woodflour plastic is used in the Northwest to fill worm-holes in otherwise sound and high-grade lumber. This plastic was developed in an attempt to salvage some of the fire-killed timber which was attacked by the round headed wood borers. This, or some other kind of plastic substance, might be forced into trees or other plants to determine he convolution of various insect burrows and help in a study of their habits.

Plastics compete with metals in many places because of their lightness, resilience, freedom from arcing and easier adaptibility. There are some kinds that are inferior to metals in rigidity, hardness of surface or other characteristics but the shortcomings of plastics are rapidly being removed by the chemist. Recently plastic window screens, made of vinylidene chloride, have been made which are non-rusting. This product may be very valuable in insect breeding work. Also it is available in a great variety of colors. Where non-metallic screens are needed this product will prove to be very welcome. Together metal and plastics are ideal in that plastics adhere well on metal surfaces and metal rods give the plastics the rigidity they might otherwise lack. A thin plastic film applied on metals through the medium of polyvinyl alcohol temporarly protects them from corrosion and tarnishing.

Rubber is ideal in many ways and for many things but plastic rubber (neoprene and vinylite), while more expensive, does the same work, does it better, and lasts longer without deterioration. It can be purchased in sheets or in tubing. Polyvinyl alcohol is also used for "rubber" tubing and gloves.

Cloth for cages, insect nets, etc., are continually being used by the entomologist. A new material, nylon, has been developed that is not only a substitute for the expensive imported silks but is an improvement on them. The entomologist may find many uses for this material in the future, in insect nets, cage material, or in graduated sieves.

Perhaps plastics will be at their best in displaying insects and their work to the public, in the museum as well as in the class room. Recently Dr. Charles E. Sando has developed a method of preserving insects, flowers and vegetables in transparent methacrylate resin, a process that does not effect their color. They are perfectly preserved and can be viewed from all angles without fear of breaking the specimens. One wonders if type specimens could be thus preserved to keep them intact for future generations. In preserving entomological material the specimen must be free from moisture

before insertion in the plastic preserving material. Urea-formaldehyde has also been used for this purpose and other resins, perhaps polystyrene, may be found to be adaptible for this purpose.

In beekeeping plastics will no doubt play a part in the future. There is no reason why plastics cannot play a big part in the future manufacture of hives, frames and foundation. At the present time cost may be an item in delaying their use but, with injection molding, hive bodies can be made in one piece in any color desired and turned out on the quantity basis. Frames also can easily be produced, which, together with the hive will be termite and rot proof. Perhaps the phenolic resins will work best here while the foundation might be made of the vinyl resins.

Moulage: Another way that plastics can be used is by employing molds, making an impression of the object to be reproduced, in clay, plaster-of-Paris, or rubber latex. When the mold is ready the plastic can then be poured in to produce any desired shapes. For this purpose specially prepared phenol-formaldehyde plastics are probably best. A mixture of plastic resin and wood flour might work well where only small amounts of the material are needed, or even for making enlarged models of insects.

Reproducing Sections: In using a microtome to section an insect for the study of some internal cavity, structure, or other part, the operator can use thin sheets of transparent plastic to represent these sections greatly enlarged. By using a large series in parallel, and cutting them proportionately, the sections can be enlarged for study. The idea of depth can be shown in a series of sections by using transparent, opaque or colored sheets of plastic.

Some resins have been developed, and others may follow as the need arises, to act as a sticky barrier on trees to hinder the passage of insects. Plastic material can also be used to fill the body cavity of insects to keep their shape intact. It can be used on large-bodied insects such as Mormon crickets, tomato worms, cutworms, white grubs, and others.

Conclusion: The use of plastics in entomology has only just begun and the possibilities of their future use is only limited by the characteristics of the materials employed. New plastic substances are constantly being developed and the older one improved to fit some industrial use or to correct a weakness in those now on the market.

The entomologist will come to rely more and more on plastic materials for use in making exhibits showing insects and their work because, once made, they will last indefinitely. With chemical and physical qualities that can be incorporated as desired, plastics will be used for exhibit material in museums and in the class room. Also in cage materials for insect breeding work and in sections or

injection media by the anatomist. Even now plastic materials are far ahead of our ability to use them and at a very reasonable cost.

A Partial List of Manufacturers of Plastics

Following is a partial list of the leading manufacturers of plastic resins together with some of the plastic materials they produce. For brevity they are abbreviated: C-casein, CA-cellulose acetate, CAB-cellulose acetate butyrate, CU-cellulose nitrate, EC-Ethylcellulose, PF-phenol-formaldehyde, P-polystyrene, M-methacrylate, Mu-moulage, UF-urea-formaldehyde, VR-vinyl resins.

1. Aladinite Co., Inc., 261 Wallace St., Orange, N. J. (C).
2. American Cyanamid Co., 49 West 49th St., New York, N. Y. (PF, UF).
3. American Plastics Corp., 50 Union Square, New York, N. Y. (C).
4. Bakelite Corp., 247 Park Ave., New York, N. Y. (CA, P, PF, UF).
5. Carbide & Carbon Chemicals Corp., 30 E. 42nd St., New York, N. Y. (P, VR).
6. Catalin Corp., 1 Park Ave., New York, N. Y. (PF).
7. Celluloid Corp., 10 E. 40th St., New York, N. Y. (CA, CN).
8. Dow Chemical Co., 919 Jefferson Ave., Midland, Mich. (EC, P).
9. E. I. duPont de Nemouers & Co. Inc., Plastics Dept., Arlington, N. J. (CA, CN, M. VR).
10. A. Knoedler Co., Lancaster, Pa. (PF).
11. General Electric Co., Plastic Dept., 1 Plastics Ave., Pittsfield, Mass. (PF, VR).
12. General Plastics Inc., 710 E. Walck Rd., N. Tonawanda, N. Y. (PF).
13. Hercules Powder Co., 999 Market St., Wilmington, Del. (CA, CAB, CN).
14. Makalot Corp., 262 Washington St., Boston, Mass. (PF, UF).
15. Marblette Corp., 37-21 Thirtieth St., Long Island City, N. Y. (PF).
16. Monsanto Chemical Co., Plastics Division, Springfield, Mass. (PF, CA, CN, VR, P).
17. Nixon Nitration Works, 125 Murray Ave., East Nixon, N. J. (CA, BN).
18. Plaskon Company, 2124 Sylvan Ave., Toledo, Ohio. (UF).
19. Rohm & Haas Co. Inc., 222 W. Washington Sq., Philadelphia, Pa. (PF, M).
20. Technical Supply Co., Palo Alto, Calif. (Mu).
21. Tennessee Eastman Corp., Kingsport, Tenn. (CA, CAB).

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THE OCCURRENCE IN KANSAS OF THE SUGAR-CANE ROOTSTOCK WEEVIL, ANACENTRINUS DEPLANTUS CSY., (COLEOPTERA, CURCULIONIDAE)*

HARRY R. BRYSON, Kansas Agricultural Experiment Station**

L. E. Melchers and James Koepper of the department of Botany called the writers attention to insect injury to plants on July 26, 1939, in a row of Shantung kaoliang growing in a sorghum variety nursery used in sorghum smut investigations at Manhattan. Small white, grub-like, footless larvae with brown heads were found in the stalks and proved to be those of a small snout beetle. Pupae and adults were also found in the cavities within the stalks but no eggs were present.

About twenty larvae and pupae were reared to the adult stage out of 75 larvae and 15 pupae obtained from cavities in the stalks. Four adults were taken from the cavities where they had emerged from the pupae and only two beetles were found crawling on the exterior. Injury to an occasional plant no doubt would escape recognition unless the plants were removed and examined. An examination of barnyard grass near the nursery in 1939 and 1940 revealed the presence of the weevils but they were not as abundant as in 1937. A heavy infestation of the weevil was found by D. A. Wilbur and Roy Fritz, investigators at the Kansas Station, in barnyard grass in low areas along the roadside near Iola, Allen County, in July, 1940. A lighter infestation was observed about the same time in Franklin County. An examination of corn in a field adjacent to one of these infested areas did not reveal the presence of the beetles. Naturally, sorghum growers would be interested in the presence of barnyard grass if such a host relationship were established.

Host plants. The first observations of the injury caused by this insect were made April 28, 1910 by D. M. Van Dine at Berwick, Louisiana. A published account of the discovery was made by Hollo-

*Contribution No. 501 from the Department of Entomology.

**This paper includes observations recorded under corn insect investigations supported by funds from project No. 9 Hatch.

way (1912). The insect was found to be a small weevil working in sugar cane below the surface of the soil. Barker found what appeared to be the same weevil working in sugar cane in a similar manner at Audubon Sugar Experiment Station, Hinds and Osterberger (1932). It was also reported from Donna and Brownsville, Texas.

These writers also point out that the weevils attracted little attention from 1912 until 1931 when a heavy infestation was in the stalks. The infestation at Manhattan was discovered late in the season after the insects had matured and had left the badly injured stalks. Specimens of the adults collected and reared were sent to the U. S. National Museum at Washington, D. C. where L. L. Buchanan identified them as one species of sugar-cane rootstock weevil, **Anacentrinus deplanatus** Csy.

OCCURRENCE AND DISTRIBUTION

Buchanan (1932) gives the distribution of the species as Washington, D. C., southern Illinois, South Dakota, Missouri, Kansas, Texas, Arkansas, Louisiana and Mississippi. Information given Osterberger and Hinds (1932) by A. F. Satterthwaite led them to conclude that the species, A. **deplanatus** Csy., is evidently the most commonly known species of this genus and that it is widely distributed from Louisiana to Kansas at least. D. A. Wilbur at the Kansas Station collected and reared several individuals from barnyard grass, (**Echinochloa crus-galli**) at Manhattan. These beetles were sent to Washington for identification along with those which the writer collected and reared from the sorghum plants.

Some of the beetles were reared from barnyard grass growing in the vicinity of the sorghum nursery in 1937 but no injury to sorghum plants in the nursery was observed at that time. Slight injury found on a sugar-cane plantation at Grandville, Louisiana, where there was a failure to get a stand of sugar-cane on 10 acres and damage occurred to the stand on 95 acres more. Furthermore, observations indicated that the insects were widely distributed over the cane belt. They also reported that in addition to the occurrence of the species on sugar-cane it had been taken from crowns of barnyard grass and bull grass **Paspalum boscianum.** The species was also found breeding to a limited extent in the roots of corn and sorghums. This is the first instance the species has been found causing injury to sorghums in Kansas, so far as the writer knows.

The weevils caused injury to several varieties of sorghums but the Shantung kaoliang plants were injured to the greatest extent. Injured plants were found in the rows in which hegaria, feterita, African kafir, Reed kafir, milos and milo crosses were grown. Larvae were found in the plants as late as September 5, 1939. None was

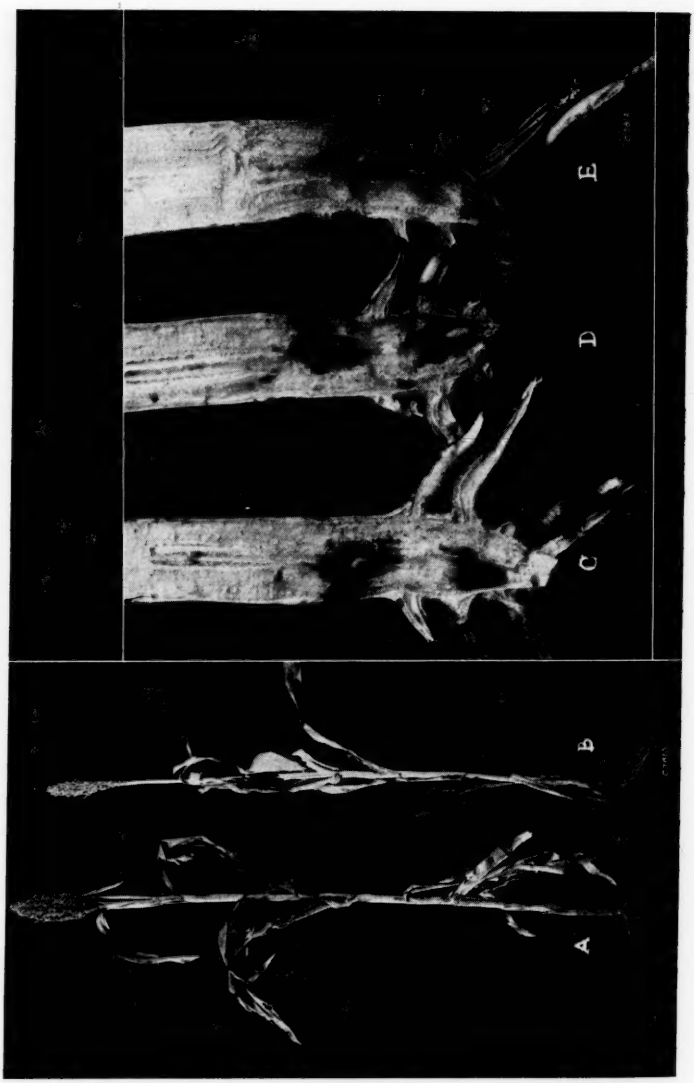

PLATE I

found in the Shantung kaoliang after August 25, 1939.

DESCRIPTION OF INJURY

The external evidence of injury to the stalks appeared late in the growing season and prior to the time for the sorghums to head. The leaves nearest the soil turned brown and took on the appearance of having been burned. Within a short time after the first leaves withered, the next higher ones up on the stalk began to die and shrivel slightly. This progressive dessication of the plant tissues continued until the entire plant became dry and brown. The seed which had formed failed to mature properly and all of the kernels were undersize.

The leaves did not shrivel to any great extent or drop from the plant. When the plant had an infestation of one or two larvae in the base of the stalk, considerable seed formed in the head. An infestation of four or more larvae destroyed the tissues to such an extent that very little if any seed was produced. Kernels formed were badly shriveled and immature. The stalks were so weak just above the surface of the soil that they lodged easily.

An examination of infested plants revealed small punctures on the exterior near the surface of the soil, which were surrounded by a purplish to brownish discoloration of the tissues. Lodged plants, when exposed to sufficient soil moisture, decomposed in much the same manner as did plants cut off and allowed to remain on the soil.

This evidence of injury was apparent from the middle of July until harvest. The majority of the injury to the stalks had been done prior to the middle of July. Attempts to remove the plants from the soil were usually unsuccessful because the stalk broke off at the surface, leaving a stub and the root system in the soil. In many instances, the roots were shriveled and showed marked signs of decay, which process continued rapidly after the plants lodged. It usually was necessary to use a spade to remove the plants with their root systems intact.

Naure of injury within the stalks. Stalks which were split open in order to determine the intensity of the infestation showed that the chief injury was caused by the larvae tunnelling cavities in the stalk

EXPLANATION OF PLATE I

A—An uninjured stalk showing normal root development, well developed head and green leaves.

B—A severely injured kaoliang plant showing shriveled stalk and leaves, a blasted head poorly developed roots.

C-D—Split halves of the same kaoliang stalk, showing characteristic cavities.
C—Larva in the cavity.
D—Pupa in the cavity.

E—Shows larva at work in a cavity, causing severe injury to the lower part of a stalk. Some root injury is also evident.

at or below the surface of the soil. Small egg laying punctures were also seen in the stalk.

The tissues within the cavities had been destroyed and removed completely. The greatest damage to the stalk apparently was done near the origin of the brace and permanent roots. Occasionally, the roots were damaged, but this type of injury did not occur except in badly infested stalks. Observations indicated that the larvae did not migrate from one cavity to another but consumed the tissues as they progressed. (Plate 1, C, D, E).

The cavities ordinarily are found most numerous in that portion of the stalk beginning about 2 inches above the surface of the soil and extending downward to the end of the tap root. Occasionally, the brace and feeder roots had been entered by the larvae.

The paired halves of the same stalk illustrates in "C" and "D" contained two cavities, the upper one occupied by a larva while the lower one contained a pupa. The cavity containing the larva was located approximately one inch above the surface of the soil, while the lower one contained the pupa, was just below the soil level. Examination of more than 100 plants indicated that there was a tendency for the larvae to move downward and to pupate in the portion of the stalk below the surface of the soil.

Often there is very little evidence on the exterior to indicate the amount of injury to the tissues within. The tissues near the bases of many of the plants were completely destroyed due to the convergence of two or more cavities. In such instances, the conducting tissues were severed so that normal physiological processes of the plant were checked entirely.

The color of the injured tissues was reddish-brown at the beginning, turning to dark brown at the time the larvae transformed to pupae. Some of the cavities measured three-eights of an inch in diameter. The internal injury, while confined to a localized region near and beneath the surface of the soil, occurred at a place where a small amount of damage to tissues results in almost a total loss of sustenance to the plant.

Other insects attacking sorghums in Kansas

The sorghums, when compared with corn, are relatively free from injurious insect pests in Kansas. The range in profitable production of certain varieties, however, may be limited by the presence of chinch bugs. Chinch bugs probably determine the boundry east of which milo and other varieties susceptible to chinch bug injury can be grown profitably. The development of atlas sorgo, a variety resistant to chinch bug injury, has made possible the extensive use of a valuable grain and forage sorghum in the eastern and southeastern part of the state where chinch bugs normally are abundant.

Probably the most important of the other insects attacking sorghums in Kansas are the kafir ant (**Solenopsis molesta** Say), corn leaf aphis (**Aphis maidis** Fitch.) and the corn ear worm (**Heliothis armiger** Hbn.). Somewhat less important pests are the grasshopper, chiefly **Melanoplus spp.**, maize bill bug (**Calandra maidis** Chittn.), sorghum webworm (**Celama sorgiella** Riley), Angumois grain moth (**Sitotroga cerealella** Oliv.), and the common stalk borer (**Papaipema nebris nitela** Guen.).

Hayes (1922) discussed the relative importance of insects attacking sorghum in Kansas. Swanson and Laude (1934) also called attention to the insects of importance in the production of sorghums in the state.

A majoriy of the cultivated crop plants used to replace the native grasses in Kansas belong to the grass family; consequently the insects which attacked the grasses of the old primary community were forced to turn to new crops planted by man, or perish.

Corn, wheat, sorghums, oats, rye, barley, and other cereals are attacked by insects which originally fed upon the native grasses. Many insects now infesting grasses may appear to be insignificant potential pests, but may become a menace to cultivated crops when ecological conditions favor their multiplication. It is evident that the sugar-cane rootstock weevil is capable of causing severe damage even in relatively few numbers. Its occurrence should be watched for and reported in order that control measures may be developed in case recurrence of the insect warrants it.

SUMMARY

1. **Anacentrinus deplanatus** Csy. one of the sugar-cane rootstock weevils has been found attacking sorghum in Kansas.
2. Infestation was greatest in Shantung kaoliang, feterita, hegari, milo, milo crosses, African kafir and Reeds kafir.
3. The manner in which it attacks the plant, and the amount of injury to the plant which one larva can cause, make the insect a possible potential pest.
4. Barnyard grass (**Echinochloa crux-galli**) is one of the native host plants for the insect. Additional host plants have not been studied in Kansas.
5. There are a few external evidences of injury prior to the time the stalks begin to lodge. Injured stalks have cavities excavated within, in which the eggs are laid, the larvae feed, pupate and transform to adults. The adults leave the stalks after they emerge.

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A NEW SPECIES OF THYREOCORINE FROM MEXICO

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Galgupha magna sp. nov.

General Charactaristics: Body broadly ovate, shining black, with distinct aeneous reflections; tarsi, beak and antennae fuscus, the latter two increasingly so distally.

Head produced one and one-half times length of eye beyond transocular line, front margin truncate to regularly rounded medially, lateral margin in front of eye straight to slightly convex. The vertex with area from occelli to apical half of tylus distinctly punctured, slightly rugose from that area to lateral margin on each side, tylus posteriorly and occipital strip with punctures faint if at all indicated. The pronotum with punctures on both anterior and posterior disc obsolete but becoming more evident laterally, quite coarse in area from eye to basal angle of scutellum. The scutellum with punctures most evident at basal angles producing a somewhat rugose area perpherally and on declivity lightly punctured, nearly smooth discally. The mesocorium and veins lightly punctured; sternites numerously punctate, tending toward smoother medially.

The sixth sternite in both sexes subangulate antero-medially and to a lesser degree sublaterally, more evidently so in male. The preceding sternites scarcely constricted medially; in female, medial length of sixth strenite equal to medial length of preceding two combined; in male, it is equal to combined length of preceding three sternites.

The ventral exposure of male hypopygium with scattered punctures. Its hind margin destinctly reflexed, slightly concave medially, a few hairs from dorsal surface visible in the concavity. The medial length of ventral exposure subequal to medial length of fifth sternite, width across posterior angles exceeding medial length of sixth sternite as 8.0 to 6.5.

The genital plates of female punctate. Their length as compared to medial length of sixth sternite as 3 to 5 and as long or longer than the postventer. Posterior margins oblique, varying from

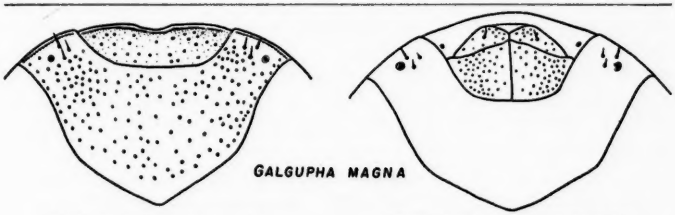
*Contribution from the Department of Entomology, University of Kansas.

straight to convex, posterior and inner margins subequal. Length 5—6.1 mm.

Comparative notes: Belongs to the **nitiduloides** complex. It is difficult to assign the exact relationship of this species within this group, because of the lack of material representing several of the species of the group; however, it is probably most closely allied to **nitiduloides texensis** McA. and M. **G. magna** sp n. appears to be the largest, least punctate, most polished of the complex.

Recorded locality and additional data: Cuernavaca, Morelos, Mexico; July 3, 1938; L. J. Lipovsky, collector.

Types: holotype, male; allotype, female; paratypes, one female in the Francis Huntington Snow collection of the University of Kansas; one paratype female in the U. S. National Museum collection.



Key to species of **nitiduloides** complex as modified by addition of **G. magna.**

1a. Metalic blue or bluish forms ---------- **caerulescens** (Stal).

1b. Castaneous to black form ---------- 2a.

2a. Genital plates on inner margins not longer, sometimes distinctly shorter than fifth sternite at center ---------- 3a.

2b. Genital plate on inner margins distinctly longer than fifth sternite at center ---------- 3b.

3a. Less numerously punctate; postero-medial part of vertex, disc of pronotum and anterior disc of scutellum, indistinctly, if at all punctate; punctures rastrate, if at all, only in transverse impression of pronotum; hind margin of hypopygium shallowly concave medially ---------- **nitiduloides texensis** McA. & M.

3b. More numerously punctate, areas mentioned with punctures more distinct often well-marked and tending toward rastrate particularly on posterior half of pronotum; hind margin of hypopygium varying from slightly concave to convex--**nitiduloides nitiduloides** (Wolff).

4a. Scutellum dull, crowded, punctate, more or less rugose and rastrate peripherally ---------- **bakeri** McA. & M.

4b. Scutellum polished, only moderately punctate ---------- 5a

5a. Length less than 4 mm. ---------- **eas** McA. & M.

5b. Length 4.75 mm. and larger ---------- **magna** sp n.

NEW WESTERN DOLICHOPODIDAE (DIPTERA)[1]

F. C. HARMSTON and G. F. KNOWLTON[2]

The following descriptions include two apparently undescribed **Dolichopus** and one **Medeterus**. The previously undescribed male of **Polymedon nigrifemoratus** Van D. also is described[3].

Dolichopus beameri n. sp.

Male: Length, 3.9 mm.; of wing 3.5 mm. Face rather wide, silvery pollinose. Front metallic green, more bronze in the middle, without any indication of pollen. Antennae wholly black, third joint slightly longer than wide, bluntly pointed. Inferior orbital cilia white, the upper black cilia descend a little more than one-third the eye height. Palpi brownish.

Dorsum of thorax metallic green, with bronze reflections; pleurae concolorous with dorsum, dulled with white pollen. Abdomen metallic bronze, the dorsum of first three segments more greenish; hypopygium black, somewhat dulled with gray pollen, its lamellae (fig. 6) moderately large, somewhat quadrilateral in outline, whitish with narrow black apical and upper margin, somewhat jagged and bristly at apex.

Coxae black, the fore pair yellowish at tip and broadly so on inner apical portions, the anterior surface clothed with short black hairs and the usual black bristles at tip; mid and hind coxae narrowly yellowish at tip. Fore femora black on outer surface, the apical third and inner surfaces yellowish brown; middle and hind femora yellow, the latter broadly blackened above at tip (in some specimens appearing narrowly blackened on entire upper edge); middle and hind femora each with a single preapical bristle, the latter ciliated on apical half of lower inner surface with pale cilia which are nearly as long as the width of femora; tibiae yellow, the posterior pair blackened, and noticeably thickened, on apical third. Fore and middle tarsi black from tips of first joint, the joints of the fore pair (fig. 4) narrowed at base, middle basitarsi each without a bristle on upper surfaces; posterior tarsi wholly black, their basitarsi noticeably thickened, appearing slightly inflated. Joints of fore tarsi as 12-5-4-3-3; of middle tarsi as 15-7-6-4-4; of hind tarsi as 16-11-7-5-4. Calypters and halteres yellow, the former with black cilia.

Wings grayish hyaline; costa with a conspicuous knot-like enlargement at the tip of first vein; last section of fourth vein bent near

[1]Contribution from the Department of Entomology, Utah Agricultural Experiment Station Project 51-A.

[2]Graduate research assistant and research associate professor, respectively.

[3]The material upon which this study is based was lent by the University of Kansas through the kindness of Dr. R. H. Beamer.

its basal third, ending considerably before the wing apex. Anal angle evenly rounded, moderately prominent.

Female: Like the male in general external appearance. Differs in face being much wider, the costa without a knot-like swelling at the tip of first vein; the posterior basitarsi are not noticeably enlarged.

Described from four males and 1 female, all taken in the Chiricahua Mountains, Arizona, July 8, 1932 by R. H. Beamer. Holotype, allotype and one paratype male returned to the Department of Entomology, University of Kansas; two paratype males retained in the insect collection of Utah Agricultural Experiment Station. This species is named in honor of Dr. R. H. Beamer of the University of Kansas, in appreciation for the large number of specimens from the excellent Snow Insect Collection which he has lent the authors.

Taxonomy: Dolichopus beameri n. sp. is much like **D. nigrilineatus** V. D., from which it may be easily distinguished by the knot-like swelling of costa and the presence of long pale cilia on inner apical half of lower edge of posterior femora; the above structures being absent in **nigrilineatus. From D. bryanti** V. D., to which it traces in the Van Duzee and Curran key (Amer. Mus. Novit. No. 683), it is distiguished by the form of the hypopygial lamellae, which in **bryanti** are somewhat triangular, with fine black spots upon the outer surface near the base, each spot giving rise to a fine hair; the lamellae in **beameri** n. sp. are quadrilateral and are wholly pale-yellow except for the black apical margin. The posterior tibiae are black except narrowly yellow at base in **bryanti,** instead of yellow with apical one-third black as in **beameri** n. sp.

Dolichopus accidentalis n. sp.

Male: Length, 4 mm.; of wing 4 mm. Face moderately wide, greyish pollinose, yet appearing slightly yellowish in certain lights. Front metallic green, more bluish in the middle. Antennae wholly black, the third joint slightly longer than wide, conical in outline, rounded at tip. Orbital cilia white, with about 6 upper cilia on each side black. Palpi blackish, the lower portion shading to a yellowish color.

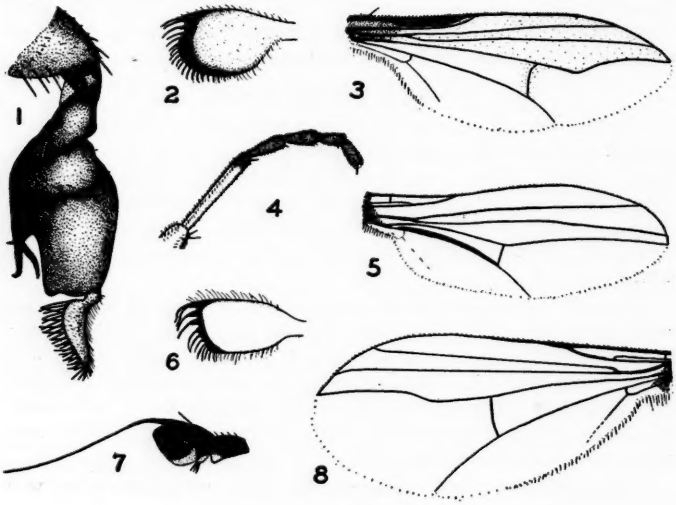
Dorsum of thorax and abdomen metallic, dark green with bronze reflections; scutellum with a few delicate pale hairs on the margin between the single pair of macrochaetae; pleurae densely dusted with greyish pollen, the greenish ground color more noticeable on upper portions. Hypopygium black, its surface slightly dulled with greyish pollen, the lamellae (fig. 2) nearly orbicular, yet jagged at apex, yellowish-white with broad black apical margin.

Coxae black, whitish pollinose, the fore and middle pairs with

black hairs upon their anterior surface, in addition to the usual black bristles at tip. Femora and tibiae yellow, the tips of posterior femora conspicuously black on upper edge, the posterior tibiae slightly thickened and black on about apical fifth; middle and hind femora each with a single preapical bristle, the latter ciliate on lower inner edge with a row of hairs of increasing length that begin near the basal third of femora and continue to the apical fourth, the shorter basal bristles more yellowish and delicate, those near apex of femora black and nearly three-fourths as long as the width of femora at its widest point; middle tibiae without a bristle below. Fore and middle tarsi yellow, blackened from the tip of first joint; fore pair with fourth and fifth joints noticeably flattened dorso-ventrally, their edges fringed with very short black bristles; middle basitarsi without a bristle on upper surface; posterior tarsi wholly black. Joints of fore tarsi as 14-8-5-4-5; of middle tarsi as 20-10-9-6-5; of hind tarsi as 20-15-10-8-5. Calypters and halteres pale yellow, the former with black cilia.

Wings (fig. 8) greyish hyaline; costa with an elongate thickened area at tip of first vein which tapers gradually toward wing tip; fourth vein broadly bent before its middle, ending considerably before wing tip; anal angle evenly rounded, not at all prominent.

Described from one male taken at Spring Creek Pass, Colorado, June 29, 1937, by C. L. Johnson. Type returned to the Department of Entomology, University of Kansas.



Taxonomy: **Dolichopus accidentalis** n. sp. traces to **nigricoxa** V. D., couplet 159, of the Van Duzee and Curran Key (Amer. Mus. Novit. No. 683) if one considered the fore tarsi to be compressed; if the fore tarsi were considered to be plain it would trace to **sincerus** Melander, couplet 171. **Dolichopus accidentalis** may readily be distinguished by having a strong preapical bristle on the posterior femora; this is absent in the **nigricoxa**; the fifth joint of fore tarsi is greatly compressed and widened, almost triangular and twice as long as the fourth segment in **nigricoxa**, whereas in **accidentalis** the fourth and fifth segments of fore tarsi are but slightly flattened and the fifth joint is barely longer than the fourth. From **sincerus**, which it resembles in general appearance; **accidentalis** differs in having cilia on the lower inner edge of posterior femora, while the hind femora of **sincerus** have, at most, a row of delicate yellowish cilia on lower edge; the fore tarsi are of plain structure in **sincerus**, are not perceptibly flattened dorso-ventrally as in **accidentalis**.

Medeterus alpinus n. sp.

Male: Length, 1.7 mm.; of wing, 1.5 mm. Face rather wide, greenish, scarcely dulled with grey pollen. Front concolorous with face yet its pollen more dense. Antennae black; third joint nearly orbicular, but slightly larger than the first or second joint; all joints and the apical arista pubescent. Orbital cilia wholly white. Proboscis black with delicate white cilia. Palpi brownish.

Thorax, including the pleurae, greenish, quite thickly dusted with grey pollen; dorsum on its anterior portion with bluish reflections; bristles of thorax wholly yellow, the scutellum with a single large pair of marginal bristles, outside of which is a pair of small hair-like bristles; acrostichal bristles small, biseriate. Abdomen dark metallic green, lightly dusted with greyish pollen, the last two segments, especially on dorsum more blackish; hairs of abdomen wholly yellow. Hypopygium and its appendages black, the former comparatively large, bent forward beneath the abdomen, rather broadly truncate at apex.

Coxae black, the anterior surface of fore and middle pairs with pale hairs and bristles; posterior coxae with a single yellowish bristle on outer surface. Femora, tibiae and tarsi yellow, the basal half of all femora, and the apical joint of all tarsi perceptably infuscated; hairs of legs delicate, pale; posterior tibiae with a sharp, slightly-curved bristle on outer edge at extreme tip, this bristle being about as long as the width of tibiae. Joints of fore tarsi as 5-3-2-2-2; of middle tarsi as 9-5-3-2-2; of hind tarsi as 6-9-5-3-3; apical joint of middle and hind tarsi considerably flattened when viewed from the side. Calypters and halteres pale yellow, the former with pale cilia.

Wings (fig. 5) grayish hyaline, the veins, with exception of the fifth vein, yellowish; fifth vein broadly flattened and black as far as posterior cross-vein, the latter about one-half the length of last portion of fifth vein; anal angle evenly rounded, prominent.

Described from one male, taken at Alpine, California, July 9, 1929, by R. H. Beamer. Type returned to the Department of Entomology, University of Kansas.

Taxonomy: **Medeterus alpinus** n. sp. traces to **M. longinquus** V. D., couplet 11, in the Van Duzee key (Phyche, 35: 39. 1928) differing from that species, however, in possessing yellow thoracic bristles; the thoracic bristles of **longinquus** are black. The only other Nearctic species of **Medeterus** having a greatly broadened fifth vein, **crassivenis** Curran, has black femora and tibiae and is thus easily distinguished from **alpinus** n. sp. in which these are yellow.

Polymedon nigrifemoratus Van D.

Male: Length, 5.5 mm.; of wing, 5 mm. Face silvery white, wide, its sides nearly parallel, yet slightly narrowed in the middle, extending below the lower corner of eyes a distance about equal to its width at narrowest point; front blackish, not shining, lightly dusted with grey pollen. Antennae (fig. 7) black, the first joint at tip below, the second and third joints on lower one-third yellowish; arista long, tapering, scarcely pubescent. Orbital cilia white, with the five upper cilia on each side and a strong bristle near the proboscis black.

Dorsum of thorax metallic green, with bronze reflections, dulled with greyish pollen, the pollen more conspicuous on lateral edges and before scutellum; scutellum with a single pair of large bristles, outside of which is a single pair of small, cilia-like hairs; acrostichals small, biseriate; dorsum of thorax on its anterior portion thickly covered with dense, short, hair-like bristles; pleurae more blackish than the dorsum, its surface densely greyish pollinose. Abdomen shining green on dorsum, the posterior margin of each segment narrowly black; venter and lateral abdominal margins densely greyish pollinose. Hypopygium (fig. 1) black, greyish pollinose; outer lamellae elongate-triangular, blackish yet more brown toward the stems; outer and lateral margins of lamellae ciliated with fine yellow-brown cilia, the cilia of inner surface black, stiff and dense.

Coxae concolorous with pleurae, the extreme tips of all pairs narrowly yellow; hairs and bristles of all coxae black. Femora black, with dense greyish pollen, all with yellow tips; middle femora with a single preapical bristle; posterior femora with a row of four large bristles ending in the usual preapical bristle. Tibiae yellow; fore

pair slightly thickened and brownish at extreme tip, possessing two slender brownish bristles at the tips, the latter extending alongside the fore basitarsus; middle tibiae without a bristle below, but with the postero-dorsal and antero-dorsal bristles strikingly prominent; fore femora of plain structure, their chaetotaxy similar to middle pair. Tarsi blackened from the tip of first joint, yet the basal portion of the second joint of middle tarsi mostly brownish; fore tarsi with first joint slightly thickened at tip, the remaining joints short, compact and somewhat enlarged, the pulvilli enlarged, prominent; middle tarsi conspicuously bowed outward between the second and third joints (as is characteristic of many males of the genus) the second joint when viewed from below somewhat widened at tip, glabrous on apical half, third joint glabrous on entire ventral surface; posterior basitarsus with a single prominent bristle on antero-ventral surface near extreme base, the remaining joints plain. Joints of fore tarsi as 18-4-3-3-4; of middle tarsi as 25-11-9-5-5; of hind tarsi as 20-23-14-8-6. Calypters yellow, of peculiar structure, the usual row of cilia situated below a greatly expanded, somewhat globose area, the latter brownish at tip, from which arises a tuft of long cilia that are pale at base, becoming almost black at tip. In some males examined the cilia are agglutinated, forming a long spur-like structure; in others the cilia are separated, forming a beautiful, golden tassel. As Aldrich pointed out (Biol. Cent.-Amer., 1: 335) it is highly probable that the cilia may be opened or closed, resulting in a strikingly beautiful secondary sexual character; halteres pale yellow.

Wings (fig. 3) greyish, with a brownish tinge in front and along the posterior cross-vein; costa greatly thickened, black, entirely filling the space between the first vein and costa; fourth vein with a broad bend before the middle of last portion; cross vein noticeably concave on its posterior side; anal angle evenly rounded, quite prominent.

The single female specimen from which this species was originally described by Van Duzee (Ann. Ent. Soc. Amer., 20: 125. 1927), is well described and there is no need for further description.

Description of male from neallotype male and seven parallotype males, all from Santa Rita Mountains, Arizona, July 7-24, 1927, collected by L. D. Anderson. A series of 21 females, all with the same collection data, also was examined. Neallotype male, four parallotype males and 16 females returned to the Department of Entomology of University of Kansas.

LEGEND

Dolichopus beameri n. sp. Male, 6, 4. **D. accidentalis** n. sp. Male, 2, 8. **Medeterus alpinus** n sp. Male, 5. **Polymedon nigrifemoratus** Van D., Male, 1, 3, 7.

A NEW SPECIES OF THE EURYTOMA RHOIS COMPLEX FROM THE SEEDS OF SCHMALTZIA (RHUS) TRILOBATA. (EURYTOMIDAE)

ROBERT E. BUGBEE, Fort Hays Kansas State College

The new species described below is temporarily placed in the rhois complex. In some respects it differs enough from typical rhois to warrant a separate complex standing. At present, however, as only two species of the rhois complex are known, it seems better to place all three together until more is known about the seed feeders confined to sumac seeds.

Eurytoma seminis, n. sp.
rhois complex

Fig. I and Plate I, Figs. 2-6.

Female—Length 2.7 to 3.5 mm.; average 3.2 mm. Largest known species of the rhois complex. Abdomen globular from a lateral view; a few (3-7) silvery white hairs on segment six, dorso-laterally; maybe also a few very short white hairs on segments 7, 8, and 9 which are longer and more numerous than in **E. rhois**; 9th abdominal segment short and stubby but averages .18 mm. in length; this is longer than in **E. rhois** which averages about .11 mm. in length; the width of the 6th abdominal segment is about 1.2 times the width of the 5th; the internal genitalia average about 1.5 mm. in length; the dorsal extension of the ventral and dorsal valves is very slight; the amount of black color on the dorsal valves and along the upper edge of the dorsal extension of the ventral valves is more extensive than in **E. rhois.** Legs—Coxae are black; trochanters deep reddish-brown; hind-femur with considerable black medially and with deep reddish-brown on outer tip; mid-femur may show a slight blackish tinge basilly but most often it is all reddish-brown; fore-femur with black basilly flaring upwards to cover from 1/3 to 3/4 of surface, rest reddish-brown; hind, mid and fore-tibia show no black but are reddish-brown being deepest medially and becoming lighter toward tips. Antenna averaging 1.02 mm. in length; filiform and with the individual segments cylindrical; scape all reddish-brown. Wings with the veins lemon yellow; postmarginal and marginal veins most often subequal in length; occasionally postmarginal shorter than the marginal; postmarginal averages .22 mm. and the marginal .25 mm. in length; stigmal club elongate and gently rounded basilly.

Males—Length ranges from 2.5 to 3.2 mm. with an average of 2.9 mm.; scape black except for slight deep reddish-brown tinge at extreme base in a few. 6th abdominal segment averages about 1½ times the width of the 5th abdominal segment.

Larvae—average in length from 3.0 to 3.5 mm. with an average

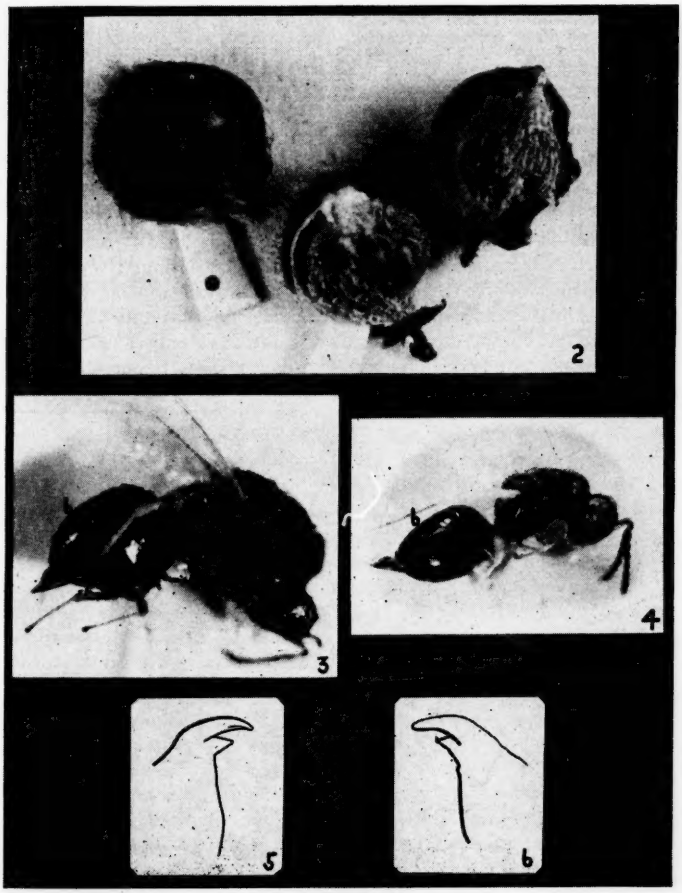


PLATE I

Figure 2. Seeds of **Schmaltzia trilobata** showing emergence holes. Seeds enlarged about 8 X.

Figure 3. Female of **Eurytoma seminis** n. sp. Enlarged 30 X. Note width of 5th and 6th abdominal segments.

Figure 4. Female of **E. rhois** Crosby. Enlarged 30 X. Note width of 5th and 6th abdominal segments.

Figures 5 and 6. Mandibles of larva of **E. seminis.** Enlarged 330 X.

of 3.2 mm. Mandibles bidentate; the upper tooth longer than the underlying second tooth. Plate I, Figs. 5 and 6.

Types—15 females and 8 males. Holotype female and paratypes of both sexes in the Bugbee collection. Paratype females and males in the U. S. National Museum.

Type locality—Hays, Kansas, 3 miles west (college pasture).

Additional localities—Woodward, Oklahoma and 15 miles north of Hays, Kansas.

Host—Schmaltzia (Rhus) trilobata, (Nutt, 1838) Barkley, 1940.

Range.—According to Barkley (1937 and 1940), **Schmaltzia (Rhus) trilobata** ranges westward from the Mississippi river to the eastern slopes of the Sierra Nevada; northward to the southern front of Alberta and southward into Mexico to the state of Puebla The phytophagous seed wasp so far is recorded only from Kansas and Oklahoma but may be expected to cover most if not all of the range of its host. (See Map. Fig. 1).

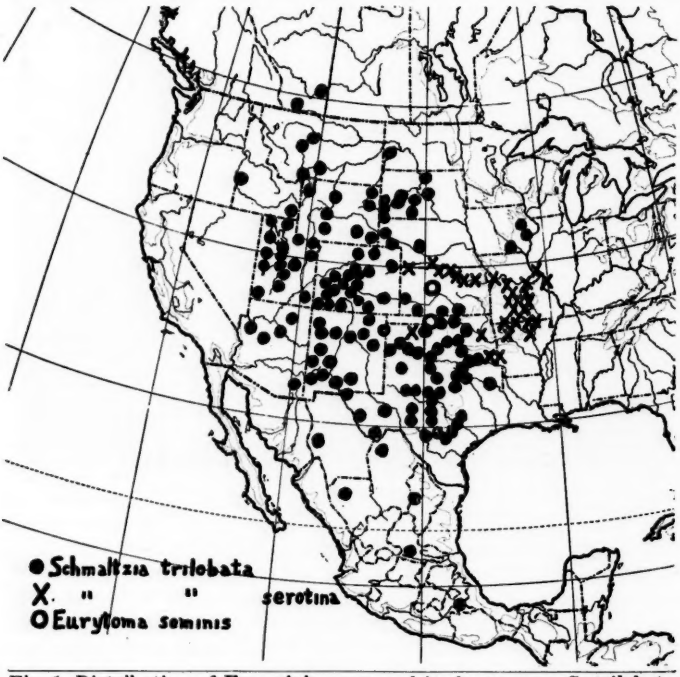


Fig. 1. Distribution of **E. seminis** n. sp. and its host sumac **S. trilobata.**

Only three species are known in the rhois complex (i. e. **Eurytoma rhois** Crosby (1909), **E. compressa** Bugbee (1939) and the one described above). **E. seminis** can be distinguished very easily from both of the other species by its much larger size, differently shaped abdomen, narrow 6th abdominal segment in relation to segment 5 in both the male and female, (plate I, Figs. 3 and 4), lack of any black on the tibia and the different host.

Notes on the Biology of E. seminis

The adults emerge from the seeds beginning in early May (actual earliest date is May 5, 1941) and continue to the last of May or early June (latest date, June 2, 1940). They leave small round holes as evidence of emergence (Plate I, Fig. 2). If the seeds are cut open during the winter the fat larvae are found to have eaten the heart out of the seeds, leaving a hollow center in which they repose. At this time of the year they are inactive and apparently not feeding. The percentage of infestation of seeds varies considerably. At one locality (Hays, Kansas) 15 of 35 seeds examined were infested, or approximately 43%. Material from another locality (Hays, Kansas, 15 miles north) yielded only 5 larvae out of 25 seeds or 20%. W. R. Van Dersal (1939) states that **S. trilobata** is a hardy shrub and should be encouraged especially where erosion control is needed. It withstands drouth conditions well. If the seeds are used to establish it, a large number should be used in order to assure results as those infested by the larvae of **E. Seminis** will be sterile. It is further of value as forage for some 19 species of birds including the prairie chicken, gambel and western quail, bobwhite and ring-neck pheasant, as well as the mule deer.

Attempts have been made to rear the larvae through to the adult in the laboratory. This was easily done with numbers of the larvae of **E. rhois** (Bugbee, 1939) but so far it has been impossible to force the larvae of **E. seminis.** The significance of this is not clear but it does emphasize a physiologic difference between the two species. On the other hand a parasite of the **Eurytoma** larvae has been forced. This species belongs to the genus **Idiomacromerus** of the family **Callimomidae** and according to Gahan, of the U. S. National Museum, seems to be identical with the genotype species **Idiomacromerus bimaculipennis** Crawford. Crawford's species was described from one specimen collected in American Fork Canyon, Utah. The number of the parasites appears to be relatively small and thus of no great consequence as a natural control measure.

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A REVISION OF TWO GENERA OF NORTH AMERICAN CERCOPIDAE (HOMOPTERA)

KATHLEEN C. DOERING, Lawrence, Kansas*

ABSTRACT

A complete revision of the genus **Aphrophora** for North America has been attempted. Two new species, **maculosa** and **fulva** are described, making a total of fifteen species for the genus. This does not include **corticea** (Germar), a European species which Ashmead (1904) reported taken in Alaska by the Harriman Expedition since no specimens have been found in any of the collections thus far studied. Three of Walker's species are still considered to be synonyms. These are: **Aphrophora fascialis** as **Aphrophora quadrinctata** Say, **Ptyelus cribatus** as **parallela** (Say), and **Ptyelus gelidus** as **saratogensis** (Fitch). **Detritus** Walker, described from Florida, is considered as a distinct species from **saratogensis** (Fitch), based on distribution, host records, and structure. The validity of Walley's species **canadensis**, **punctipes**, and **princeps**, which Ball (1934) opposed has been confirmed through the study of longer series of specimens and more careful comparisons. Separate keys to males and females have been made in an attempt to use characters which will assist workers in classifying with greater accuracy female specimens when no male specimens occur along with them to verify them by the distinctive male plates. Drawings of the head and pronota of the females and genital plates and last sterna of the males are included.

Comparative notes concerning **Clastoptera globosa** Fowler are given and the key to the species and varieties in this genus has been revised to include this species, which recently has been collected at Brownsville, Texas.

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*Contribution from the Department of Entomology, University of Kansas.

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APHROPHORA

Key to Female Specimens

1. Median length of head greater than one-third of greatest width of head; frons greatly protruding so that postclypeus is conspicuously visible from above ---------- **parallela** (Say) (northeastern)

Median length of head not over one-third of greatest width or only slightly so; postclypeus not conspicuously visible from above ---------- 2

2(1). Width of head greater than width of pronotum; lateral margins of pronotum parallel; base of costa and two distinct spots on costal margin white-- ---------- **quadrinotata** Say (east of Rockies)

Pronotum as wide as head or slightly wider; lateral margins of pronotum diverging posteriorly; no distinct white spots except in **annulata** ---------- 3

3(2). Lateral margin of vertex between eye and frons equal to median length of head ---------- 4

Lateral margin of vertex longer ---------- 6

4(3). Tegmina broad, costa ampliate, two large light spots along costal region ---------- **angulata** Ball (Cal. and Wash.)

Tegmina slender, more nearly parallel-sided; no distinct light colored costal areas ---------- 5

5(4). Head somewhat conically produced, the median length one-third its width ---------- **salicis** DeGeer (introduced)

Head roundingly produced, its median length less than one-third its width ---------- **signoreti** Fitch (north central—restricted)

6(3). Median length of head less than one-third median length of pronotum ---------- **punctipes** Walley (Cal. and Wash.)

Median length of head over one-third median length of pronotum ---------- 7

7(6). Median length of vertex distinctly longer than lateral margin of pronotum; median length of head approximately one-half median length of pronotum; usually a broad, irregular cream stripe across head and anterior part of pronotum------ **saratogensis** (Fitch) (northeastern)

Median length of vertex not longer or only slightly longer than lateral margin of pronotum; median length of head considerably less than one-half length of pronotum (expect **canadensis**); cream stripe not more than a line ----------8

8(7). Median length of head much over one-fourth the total width of head ----------**annulata** Ball (western mountains; rare)

Median length of head either one-fourth or only slightly over and under one-fourth of total width---------9

9(8). Median length of head one-half median length of pronotum ----------**canadensis** Walley (Cal. and Brit Col.)

Median length of head less than one-half median length of pronotum ----------10

10(9). Median length of head one-fourth of width of head or over ----------11

Median length of head less than one-fourth width of head ----------13

11(10). Median length of frons longer than median length of vertex ---------- **irrorata** Ball (Southwestern and western)

Median length of frons equal to or less than median length of vertex ----------12

12(11). Ocelli small; distance from ocelli to posterior margin of vertex twice diameter of ocelli ---------**detritus** Walker (Southeastern)

Ocelli large; distance from ocelli to posterior margin of vertex equal to diameter of ocelli -**permutata** Uhler (western; common)

13(10). Dark, uniformly punctured with dark -------**princeps** Walley (Cal. and extreme northwest)

Tawny-colored, inconspicuously mottled with light --------14

14(13). Median length of head one-fourth combined length of head and thorax; peak of carina on vertex in line with anterior margin of ocelli ---------**maculosa** n. sp. (California)

Median length of head over one-fourth combined length of head and thorax; peak of carina halfway on vertex or anterior to ocelli ----------**fulva** n. sp. (Cal.)

Key to Males

1. Combined genital plates with a deep, rectangular median notch, united only through basal fourth, each plate shallowly arcuate ----------**quadrinotata** Say
Combined genital plates not notched, or if so notch is triangular, united through more than basal fourth, plates not longitudinally arcuate ----------2

2(1). At least distal third of plates considerably narrowed, ending as arm-like projections ----------3
Distal third not forming a narrowed projection; either truncate or roundingly pointed at apex ----------7

3(2). Each plate not more than one-third longer than its basal width ----------4
Each plate at least more than one-half longer than its basal width ----------5

4(3). Each plate at base equal to length, with a broad, truncate, darkly colored apex ----------**annulata** Ball
Each plate about one-third longer than its basal width and its apex more pointed --------**signoreti** Fitch

5(3). Median length of 9th sternum considerably over twice median length of 8th sternum; genital plate more slender, constricted just before apex to one-half width at middle; deep brown colored insects------ ----------**permutata** Uhler
Median length of ninth sternum twice length of eighth sternum; genital plate expanded through middle, constricted at apex to less than one-half median width ----------6

6(5). Length of genital plate equal to median length of ninth sternum; combined width of genital plates at apex less than width of one plate through middle ----------**maculosa** n. sp.
Length of genital plate about one-third longer than ninth sternum; combined width of genital plates at apex equal to width of middle ----------**fulva** n. sp.

7(2). Each genital plate truncate, posterior margin shallowly concave ----------8
Genital plate with pointed apex ----------10

8(7). Genital plates united at middle for a distance less than one-half their length; mesal angle of each plate sharply projecting, somewhat depressed so that it is not on same plane as rest of plate from ventral view ----------**irrorata** Ball

Genital plates, united at middle for three-fourths their length; mesal angle not conspicuously projected; not depressed, or only slightly so ----------9

9(8). Basal width of one plate less than greatest length, mesal angle reflexed, notch between plates wider than width of plate ----------**princeps** Walley

Basal width of one plate greater than length, mesal angle not reflexed; notch inconspicuous ----**angulata** Ball

10(7). Greatest length of genital plate at outer margin, length of plate and ninth sternum about equal; median length of vertex slightly longer than median length of frons ----------11

Greatest length of genital plate in middle or mesad of middle; length of plate either much longer or much less than length of ninth sternum; median length of vertex equal or less than length of frons------12

11(10). Length of plate about one-sixth greater than width; ninth sternum one-half of eighth; median length of vertex longer than lateral margin of pronotum ----------**saratogensis** (Fitch)

Width of plate subequal to length; ninth sternum two-thirds of eighth sternum; median length of vertex equal to lateral margin of pronotum------ ----------**detritus** Walker

12(10). Ninth sternum much longer than length of genital plate ----------13

Ninth sternum much shorter than length of genital plate ----------14

13(12). Median length of ninth sternum not quite twice median length of eighth sternum; median length of frons much longer than median length of vertex; postclypeus greatly inflated ----------**parallala** (Say)

Median length of ninth sternum more than twice median length of eighth sternum; median length of frons and vertex equal; postclypeus not inflated ----------**canadensis** Walley

14(13). Ninth sternum less than one-half length of eighth; genital plates more than twice length of ninth sternum; frons longer than median length of vertex ----------**punctipes** Walley

Ninth sternum two-thirds as long as eighth sternum; genital plates approximately one-third longer than ninth sternum; frons and vertex equal ----**salicis** DeGeer

(To be concluded in the October issue)

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Vol 14, No. 3, July, 1941